higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS

6 April 2021

This marking guideline consists of 8 pages.

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QUESTION 1

1.1 False
1.2 True
1.3 True
1.4 False
1.5 False
1.6 False
1.7 False
1.8 True
1.9 True
1.10 False

(10 × 1) **[10]**

QUESTION 2

2.1

$$R_p = \frac{R_2 \times R_1}{R_2 + R_1}$$

$$R_P = \frac{2 \times 2}{2 + 2} \checkmark$$

$$R_P = \frac{4}{4}$$

$$R_P = 1\Omega \checkmark$$

$$\frac{1}{R_P} = \frac{1}{R_3} + \frac{1}{R_4} + \frac{1}{R_5}$$

$$\frac{1}{R_P} = \frac{1}{40} + \frac{1}{20} + \frac{1}{40} \checkmark$$

$$R_P = \frac{1}{0.1}$$

$$R_P = 10\Omega \checkmark$$

$$R_T = 1 + 10$$

$$R_T = 11\Omega \checkmark\checkmark$$ (6)

2.2

$$I_T = \frac{V}{R}$$

$$I_T = \frac{132}{11} \checkmark$$

$$I_T = 12A \checkmark$$ (2)

2.3 $V_{P1} = I_T \times R_{P1}$
$V_{P1} = 12 \times 1$ ✓
$V_{P1} = 12V$ ✓

$V_{P2} = I_T \times R_{P2}$
$V_{P2} = 12 \times 10$ ✓
$V_{P2} = 120V$ ✓

$I_2 = \frac{V_{P1}}{R_2}$
$I_2 = \frac{12}{2}$ ✓
$I_2 = 6A$ ✓

$I_4 = \frac{V_{P2}}{R_4}$
$I_4 = \frac{120}{20}$ ✓
$I_4 = 6A$ ✓

$I_5 = \frac{V_{p2}}{R_5}$
$I_5 = \frac{120}{40}$ ✓
$I_5 = 3A$ ✓ (10)
[18]

QUESTION 3

3.1 3.1.1 $\frac{2\pi}{3} \times \frac{180}{\pi} = 120°$ ✓✓

3.1.2 $\frac{3\pi}{4} \times \frac{180}{\pi} = 135°$ ✓✓

3.1.3 $\frac{5\pi}{4} \times \frac{180}{\pi} = 225°$ ✓✓

(3 x 1) (3)

In each of the above, 1 mark

3.2 3.2.1 $X_L = 2\pi fL$
$L = \frac{X_L}{2\pi f}$
$L = \frac{39{,}25}{2\pi(50)}$
$L = 125mH$ (3)

3.2.2 $X_C = \frac{1}{2\pi fC}$

$C = \frac{1}{2\pi(50)(31{,}831)}$

$C = 100\mu F$ (3)

3.2.3 $Z_T = \sqrt{R^2 + (X_L - X_C)^2}$

$Z_T = \sqrt{8^2 + (39{,}25 - 31{,}831)^2}$

$Z_T = 10{,}912\Omega$ (4)

3.2.4 $I = \frac{V}{Z}$

$I = \frac{250}{10{,}912}$

$I = 22{,}911A$ (3)

3.2.5 $\theta = Cos^{-1}\frac{R}{Z}$

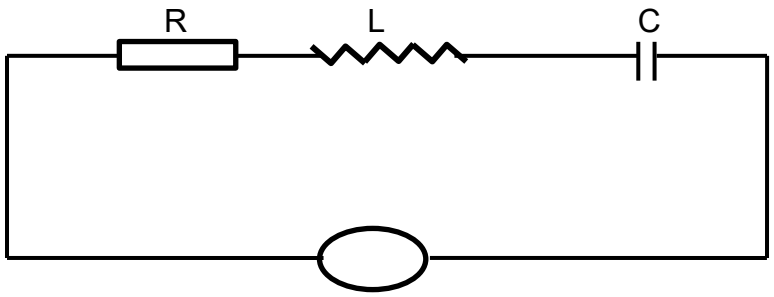
$\theta = Cos^{-1}(\frac{8}{10{,}912})$ ✓

$\theta = 42{,}862°$ ✓

Or use $\theta = tan^{-1}\frac{XL-XC}{R}$

(3)

3.3



(1)
[20]

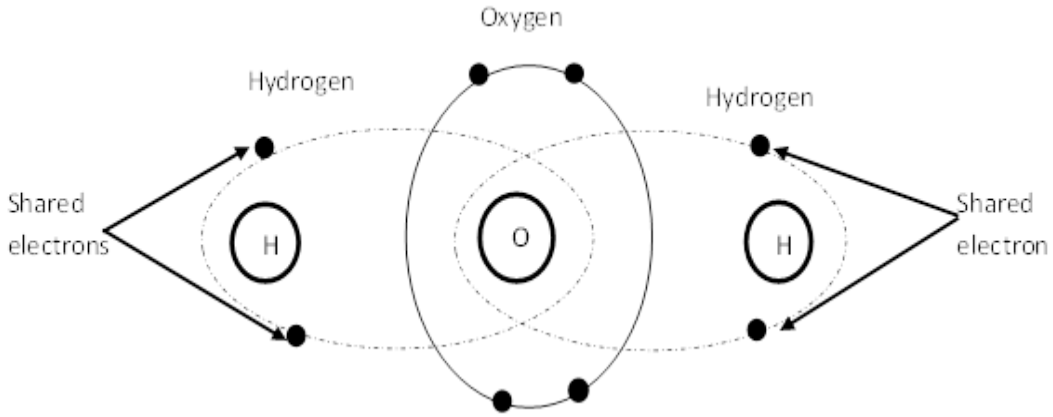
QUESTION 4

4.1 4.1.1 Force of attraction; The electrons being negatively charged, are attracted to the positively charged nucleus.

4.1.2 Centrifugal force; The electron revolves around the nucleus at high velocities and as a result is forced away from the nucleus.

(2 × 2) (4)

4.2 Covalent bonds.



(5)

Include explanation in relation to sketch, as demanded by question

4.3 During the positive half cycle, when diode D_1 is forward biased,✓ current will flow✓ and the capacitor C_1 will charge up to the peak input voltage (V_m).✓

During the negative half cycle, when the diode D_1 is reverse biased,✓ there will be no flow of current,✓ and the capacitor will discharge through the load.✓ (6)

[15]

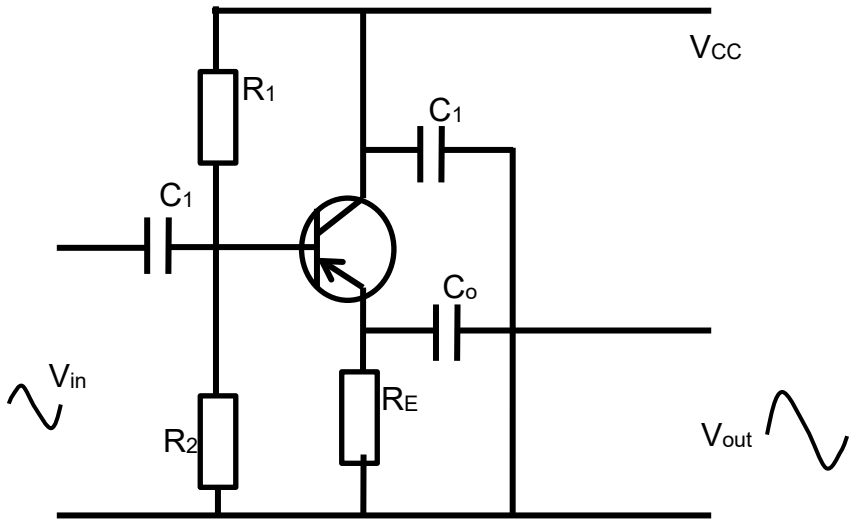
QUESTION 5

5.1 5.1.1
- Cut-off region
- Saturation region (2)

5.1.2 Active or linear region (1)

5.2
- Common emitter
- Common base
- Common collector (3)

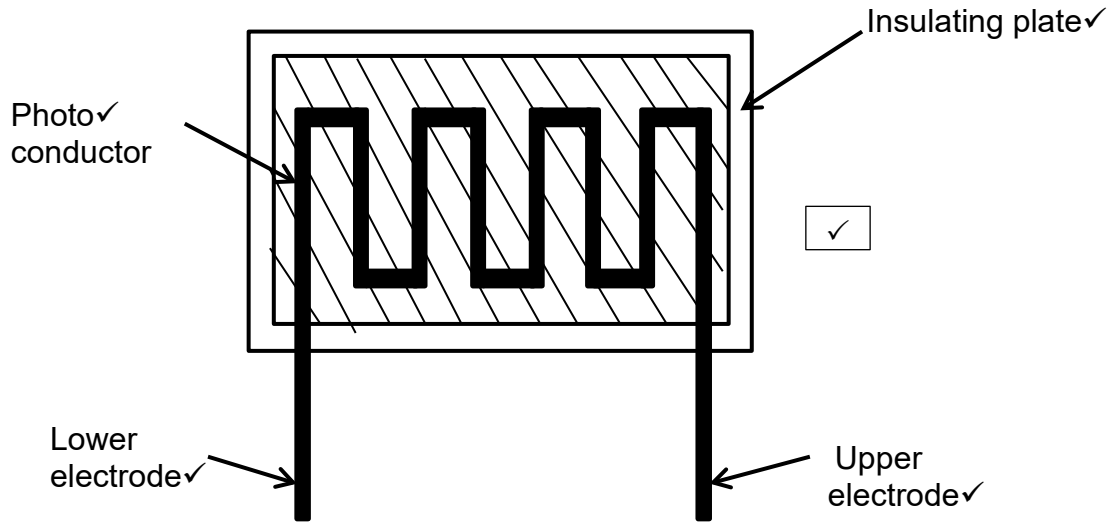
5.3



Each component, including input and output = ½
PNP transistor = 1 (5)
[11]

QUESTION 6

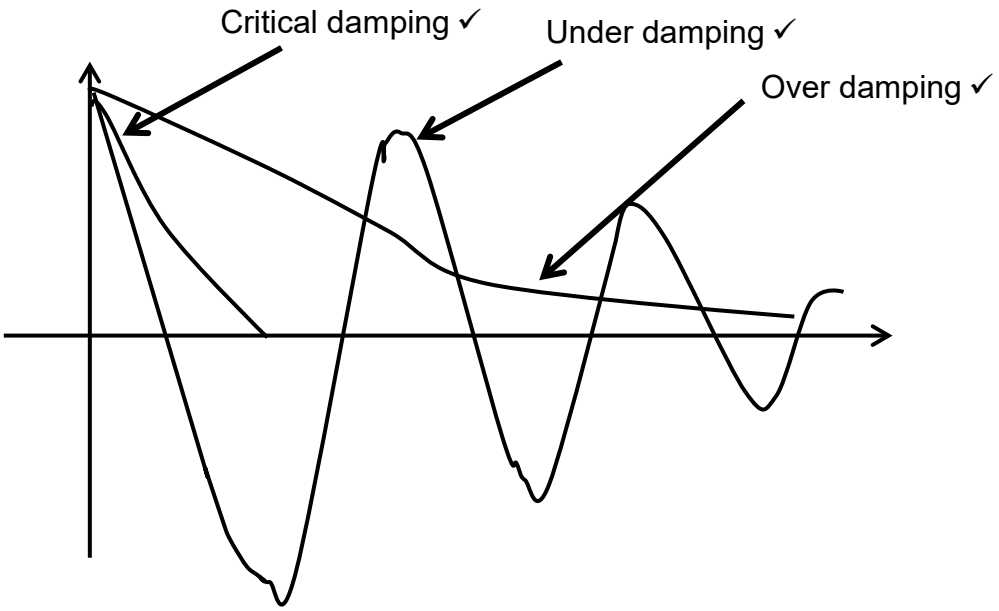
6.1.1



(5)

6.1.2 When incident light falls on the device, its resistance decrease, causing a current to flow through the device. (2)

6.2



(3)

6.3 $P = I^2 \times R$

$P = (2 \times 10^{-3}) \times 600$ ✓

$P = 2{,}4mW$ ✓

$N_p = 10log\frac{P_{out}}{P_{in}}$

$40 = 10log\frac{P_{out}}{2{,}4mW}$ ✓

$\frac{40}{10} = log\frac{P_{out}}{2{,}4mW}$

$antilog4 = \frac{P_{out}}{2{,}4mW}$

$P_{out} = 24W$ ✓

$P_{out} = \frac{V_{out}^2}{R_{out}}$

$24 = \frac{V^2}{10}$ ✓

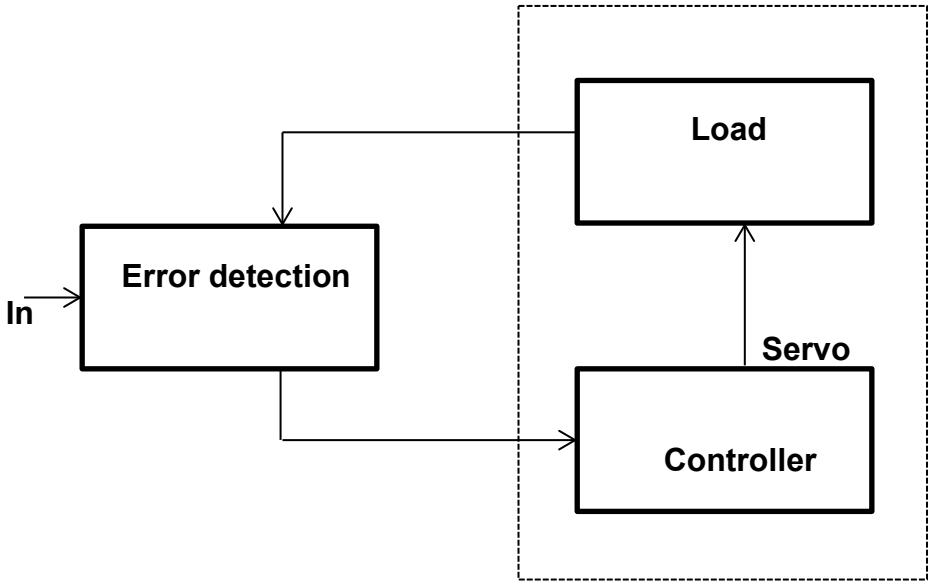
$V = \sqrt{24 \times 10}$

$V = 15{,}492\,V$ ✓

(6)
[16]

QUESTION 7

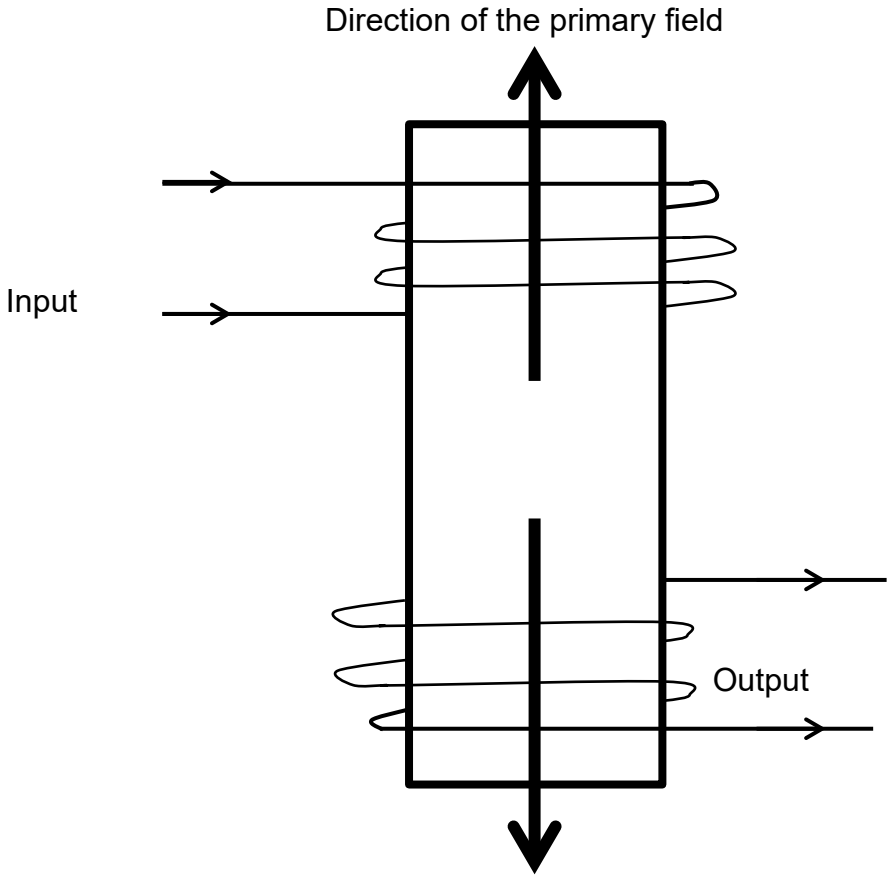
7.1 Complete servo-system



(5)

Show breakdown

7.2



(5)
[10]

Or any equivalent diagram that illustrates Lenz's law

TOTAL: 100

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